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Contractor :

METZ University, Faculty of Sciences
Laboratory of Physics and Mechanics of
Materials, METZ, FRANCE

Research project :

Experimental Investigation of Adiabatic Shear Banding at Different Impact Velocities

Principal Investigator : J.R. KLEPACZKO

3 rd Interim REPORT
from : May 19,1991 to : Nov. 18,1991

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REPORT DOCUMENTATION PAGE

R/D

ERO Proposal Number : RAND D 6148-MS-01
Contrat Number : DAJA 45-90-C-0052

Title of proposal : **Experimental Investigation of Adiabatic Shear Banding at Different Impact Velocities**

Report Number : 03/91
Period covered : May 19/91 to Nov. 18/91

Name of Institution : Metz University, Faculty of Sciences, Laboratory of Physics and Mechanics of Materials, Metz, France

Principal Investigator : J.R. KLEPACZKO

ABSTRACT

During the interim period, May 19- Nov. 18,1991, the final operational stage in development of the new experimental technique have been achieved. This technique enables for studying a fast plastic deformation and development of adiabatic shear bands at different displacement velocities. The technique is being tested using newly aquired measuring devices, i.e. non-contact optical extensometer/displacement gauge, and H.P. fast oscilloscope.

In addition, numerical studies of plastic zones in the double shear specimen have been started using the computer code "ABAQUS".

Finally, some contacts with the French Army Laboratory (ETCA) has been undertaken to prepare steel specimens for a final testing.

1. The current status of the projet

Within the framework of the research contract entitled "Experimental Investigation of Adiabatic Shear Banding at Different Impact Velocities" (contract number : DAJA 45-90-C-0052), the following activities have to be reported :

i. The mechanical part of the experimental setup is operational (air gun and transmitter tube) ;

ii. The mesuring part of the experimental setup is newly put into operation, (non-contact extensometer/displacement gage, SR gages, amplifiers and digital H.P. oscilloscope) ;

iii. Preliminary tests have been performed using a complete experimental setup (steel 1018) ;

iv. Because of a complicated spatial distribution of plastic deformation in the double-shear specimen the Finite Element technique has been applied to optimize specimen geometry.

v. The new experimental technique has been shown, and discussed, during the visit of the Principal Investigator (J.R. Klepaczko) in the US Army Materials Technology Laboratory, WATERTOWN, Massachussets, USA (contact with dr. S.C.CHON)

2. Further details on curret activities

Since the new experimental technique was briefly described in the Interim Report # 2, here, further technical informations will be provided using the previous description. A few "complete" tests have been performed applying at the same time the recording system of the impact velocity of a projectile, the non-contact optical extensometer, SR gages of the transmitter tube, amplifier and digital oscilloscopes. Those preliminary tests are at present under analysis.

It has been found that the specimen geometry which was applied in the preliminary tests should be slightly changed because of additional plastic deformation at the support surface. A more exact numerical analyses have been performed at different levels of the nominal plastic deformation in shear. Fig. 1a, 1b and Fig. 2a, 2b show respectively distributions of shear stresses and shear strains at two stages of nominal deformation in shear γ, $\gamma_1 = 2.5 \times 10^{-3}$ and $\gamma_2 = 0.5$. The stress and strain fields are relatively uniform at different levels of nominal strain.

During the visit of the Principal Investigator (J.R. Klepaczko) in the US East Coast a direct contact has been established between Chief of Materials, Dynamics Branch, Materials Technology Laboratory, Dr. Watertown, MA (Dr. S.C. Chon). In addition, a seminar has been arranged in the MTL - Wartertown : "Review of Experimental Techniques for Studying Adiabatic Shear Bands". After the seminar a discussion was continued with the Laboratory staff. The visit took place in June 91.

After discussion with the Head of the Etablissement Technique Central de l'Armement (Y. Remillieux) it has been decided that the first series of tests will be performed on steel specimen prepared by ETCA/Paris.

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FIG. 1a , DISTRIBUTION OF SHEAR STRESS AT NOMINAL SHEAR STRAIN 2.5×10^{-3}

S12

	VALUE
1	-2.00E+02
2	-1.70E+02
3	-1.40E+02
4	-1.10E+02
5	-8.00E+01
6	-5.00E+01
7	-1.97E+01
8	+1.00E+01
9	+4.00E+01
10	+7.00E+01
11	+1.00E+02

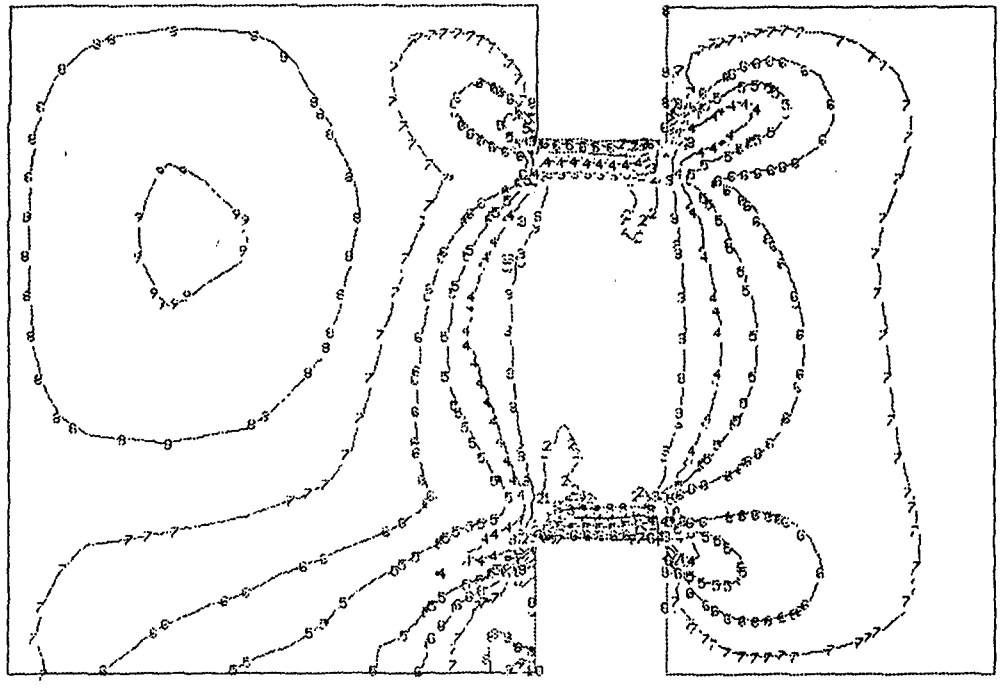

FIG 1b , DISTRIBUTION OF SHEAR STRAIN AT NOMINAL SHEAR STRAIN 2.5×10^{-3}

E12

	VALUE
1	-4.00E-02
2	-3.50E-02
3	-3.00E-02
4	-2.50E-02
5	-2.00E-02
6	-1.50E-02
7	-1.00E-02
8	-5.00E-03
9	+5.00E-09
10	+5.00E-03
11	+1.00E-02

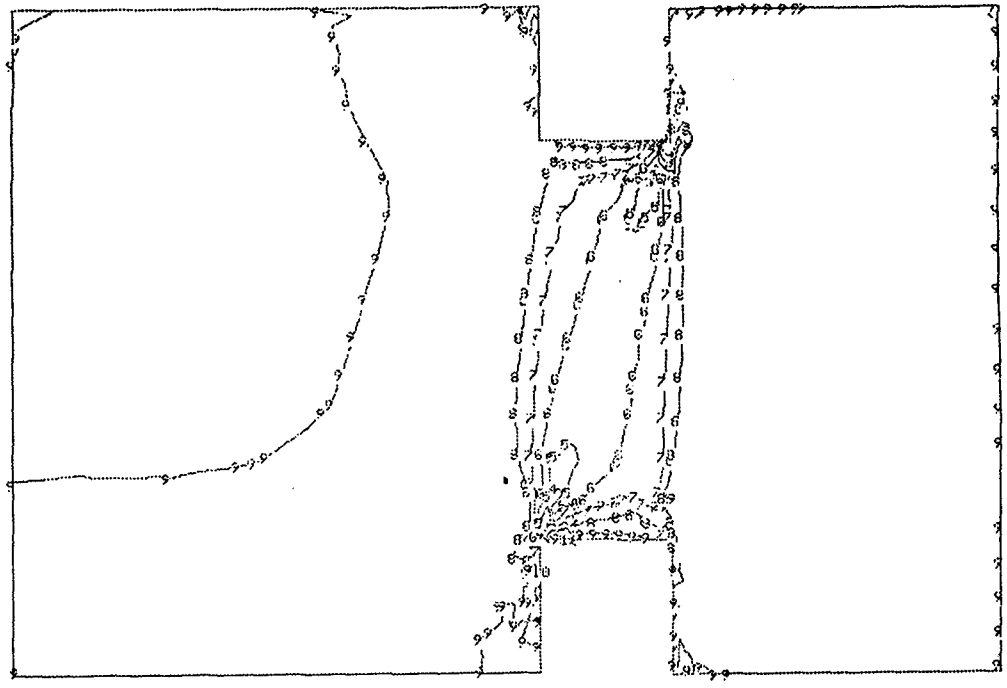

FIG. 2a , DISTRIBUTION OF SHEAR STRESS AT NOMINAL STRAIN 0.50

S12

	VALUE
1	-3.00E+02
2	-2.40E+02
3	-1.80E+02
4	-1.20E+02
5	-5.99E+01
6	+0.00E-05
7	+6.00E+01
8	+1.20E+02
9	+1.80E+02
10	+2.40E+02
11	+3.00E+02

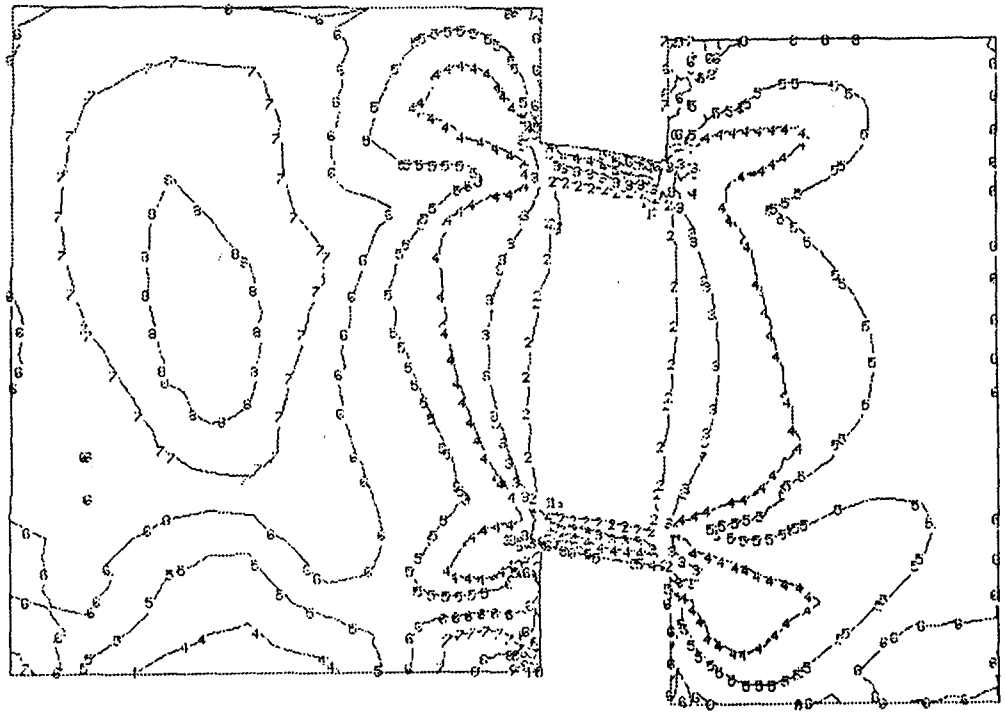

FIG. 2b , DISTRIBUTION OF SHEAR STRAIN AT NOMINAL STRAIN 0.50

E12

	VALUE
1	-4.60E-01
2	-3.40E-01
3	-2.60E-01
4	-2.20E-01
5	-1.60E-01
6	-1.00E-01
7	-3.99E-02
8	+2.00E-02
9	+8.00E-02
10	+1.40E-01
11	+2.60E-01